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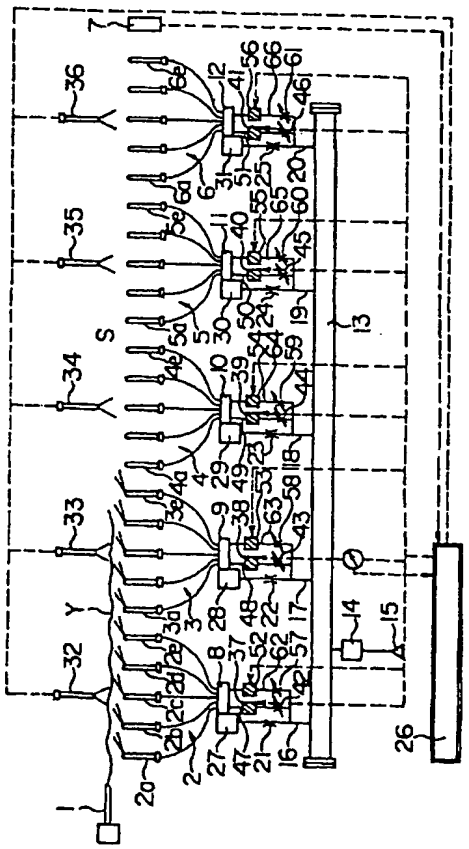
(54) Method of controlling weft insertion in a jet loom.

(57) To provide a method of controlling weft insertion in a jet loom which can ensure safe and complete weft insertion through a shed even under the influence of a change in weft flying speed, acceleration or deceleration, due to a change in air injection from the auxiliary nozzles and provide uniform hand in the resulting fabric. Method of controlling weft insertion is adapted for use in a jet loom having at least one weft detector (32-36) for detecting the leading end of an inserted weft (y) for each weft insertion at a position defined by said weft detector (32-36) on the way of weft flying along a weft insertion passage of the loom to determine a time at which said leading end arrives at said position and a plurality of auxiliary nozzles (2a-2e,3a-3e,4a-4e,5a-5e,6a-6e) whose operation may be controlled according to a signal from said weft detector (32-36). The method is characterized in that said time at which the leading end of said inserted weft (y) has actually arrived at said position is compared with a reference weft arrival time, and fluid injection from any auxiliary nozzles (2a-2e,3a-3e,4a-4e,5a-5e,6a-6e) located upstream and downstream of said position of the weft detector are compensated for as required according to information from the comparison.

Fig. 1



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INDUSTRIAL FIELD OF UTILIZATION

The present invention relates to a method of controlling weft insertion in a jet loom and, more specifically, to the above method in a jet loom having at least one weft detector generating a signal which is representative of a time at which the leading end of an inserted weft has arrived at a position defined by the weft detector and a plurality of auxiliary nozzles whose operation may be controlled according to the above signal.

PRIOR ART

A jet loom wherein a weft is inserted into a warp shed by air jet from a main weft inserting nozzle is equipped with a plurality of auxiliary nozzles which are disposed along weft flying passage in the shed for injecting air jets successively for accelerating the inserted weft thereby to assist it in flying safely through the shed. The auxiliary nozzles are activated sequentially so that air jets are issued one after another from the nozzles in downstream direction with respect to the weft flying passage, and the times of activating individual auxiliary nozzles are previously established for each different kind of weft to be inserted.

Publication of unexamined Japanese patent application No. 58-36242 (1983) discloses a weft insertion controlling method, according to which the times of air injection by those auxiliary nozzles located downstream of a weft detector are controlled in response to a weft arrival time signal from that weft detector.

Another publication of unexamined Japanese patent application No. 62-257441 (1987) proposes a method, according to which air injection pressures of the individual auxiliary nozzles, as well as the air injection times thereof, are controlled as required by the information from the weft detector. That is, in the event that an inserted weft fails to arrive at the weft detector timely in a predetermined range of permissible time, or the weft arrival time being either too early or too late, the air injection pressure of the auxiliary nozzles located downstream of the weft detector is adjusted so that the weft flying speed is accelerated or decelerated as required.

To be more specific, the apparatus for performing the above method includes separate air supply reservoirs holding therein air under different pressures, wherein if the weft detector is actuated to detect the leading end of an inserted weft later than required, the auxiliary nozzles downstream of that detector are supplied with air under higher pressure from one reservoir for accelerating the weft, while if too early arrival of the weft leading end is detected by the weft detector, the auxiliary nozzles receive air under lower pressure from the other reservoir for decelerating the weft. Provision of the two separate air reservoirs is intended to speed the operational response of the auxiliary nozzles to a signal transmitted from the weft detector.

PROBLEMS THAT THE INVENTION IS TO SOLVE

According to the weft insertion controlling method of the above publication No. 62-257441, wherein a delay in weft arrival at the weft detector is compensated for by increasing the air injection pressure only for the auxiliary nozzles located downstream of the weft detector, the time allowed for remedying the delay by acceleration is limited and, therefore, substantially high pressure of air is required for the necessary compensation. However, injection of such high pressure air for the acceleration may cause excessive tension to the weft and invite a failure in weft insertion due to a weft break.

The present invention is intended to solve the above problems by providing a weft insertion controlling method in a jet loom which method can ensure safe and complete weft insertion through a shed even under the influence of a change in weft flying speed, acceleration or deceleration, due to a change in air injection from the auxiliary nozzles.

MEANS SOLVING THE PROBLEMS

In order to solve the above problems, there is provided a weft insertion controlling method in a jet loom having at least one weft detector for detecting the leading end of an inserted weft for each weft insertion at a position defined by said weft detector on the way of weft flying along a weft insertion passage of the loom to determine a time at which said leading end arrives at said position and a plurality of auxiliary nozzles whose operation may be controlled according to a signal from said weft detector, said method being characterized in that a time at which the leading end of said inserted weft has actually arrived at said position is compared with a predetermined reference weft arrival time, and fluid injection from any auxiliary nozzles located. upstream and downstream of said position of the weft detector are compensated for as required according to information from the comparison.

OPERATION OF THE INVENTION

In response to a signal from the weft detector, any auxiliary nozzles located not only on the downstream side of that weft detector then responding to the signal, but also on the upstream side thereof, are activated. For example, when the signal represents that the weft has arrived at the weft detector later than required by the reference arrival time, the weft is subjected to air jets issued from the auxiliary nozzle both downstream and upstream of the weft detector, so that accelerating action is applied to the weft over a substantially long portion thereof and the delay in weft flying can be recovered timely without causing harmful tension to the weft.

EMBODIMENTS

The following will describe an embodiment of the weft insertion controlling method according to the invention as applied to a jet loom shown specifically in FIG. 1 of the accompanying drawings. Figs. 1 through 5 show an embodiment of the apparatus for disposing of a weft piece in a jet loom according to the present invention and details thereof. The Fig. 1 to 5 show the following:

- FIG. 1 is an illustrative schematic view showing a jet loom equipped with a weft insertion apparatus to which an embodiment of weft insertion controlling method of the invention may be applied;
- FIG. 2 is an enlarged schematic view showing part of the weft insertion apparatus of FIG. 1;
- FIG. 3 is a diagram showing a manner of air injection from auxiliary nozzles in accelerating an inserted weft in an embodiment of the invention;
- FIG. 4 is a diagram showing a manner of air injection from auxiliary nozzles in decelerating an inserted weft in an embodiment of the invention; and
- FIG. 5 is a diagram showing a manner of air injection from auxiliary nozzles in accelerating an inserted weft according to another embodiment of the invention.

Referring to FIG. 1, the loom includes a main nozzle 1 for inserting a weft Y into a warp shed by an air jet issued therefrom. The inserted weft Y is assisted in flying through the shed by air jets injected successively from groups of auxiliary nozzles 2, 3, 4, 5, 6 to accelerate the weft so that its leading end arrives timely at a weft feeler 7 which is located at a predetermined terminating extremity position of weft flying passage beyond the shed across the loom. Each of the auxiliary nozzle groups 2-6 comprises a plurality of nozzles 2a, 2b, 2c, 2d, 2e; 3a-3e; 4a-4e; 5a-5e; 6a-6e. The auxiliary nozzles of each group are connected to a common air distributors 8, 9, 10, 11 or 12, so that the auxiliary nozzles of each group inject air under the same pressure.

There is provided an elongated hollow air reservoir 13 located across the loom and holding therein compressed air. The air reservoir 13 has an inlet connected to any suitable air source 15 through a regulator 14 for adjusting the air pressure in the reservoir and outlets connected to the respective distributors 8-12 through conduit lines 16-20 which have therein fixed throttle valves 21-25 for restricting the flow of air therethrough to their associated auxiliary nozzles to adjust the air injection pressure of the nozzles with respect the air pressure in the reservoir 13. The lines 16-20 include solenoid-operated valves 27-31 and the time at which each solenoid is energized to open its associated valve is controlled by a controller 26.

The loom includes a plurality of weft detectors 32-36 disposed along the weft flying passage in a warp shed for detecting the time at which the leading end of each inserted weft just arrives at each of such detector and connected to the controller 26 for transmitting thereto signals which are representative of the arrival times of the weft leading end at the respective weft detectors 32-36. As shown in FIG. 1, the controller 26 is connected also to the weft feeler 7 for receiving therefrom a signal indicative of the time at which the leading end of the inserted weft Y arrives at that weft feeler. The controller 26 has stored therein reference information on the ranges of permissible arrival time for the respective groups of auxiliary nozzles and has a function of comparing actual arrival times with such reference information. The controller 26 is adapted to receive other signals indicative of other information necessary for controlling the weft insertion, e.g. air pressure in the reservoir 13 which is detected by a pressure sensor 37 connected to the reservoir.

As indicated also in FIG. 2, there are provided first bypass lines 47-51 connected between the main lines 16-20 and the distributors 8-12 so as to bypass the throttle valves 21-25 and the solenoid valves 27-31 in the main lines and second bypass lines 62-66 connected similarly as the first bypass lines. The first and second bypass lines 47-51 and 62-66 have their own solenoid-operated valves 37-41 and 52-56, whose operation is controlled by the controller 26, and adjustable throttle valves 42-46 and 57-61, respectively.

Now referring specifically to the auxiliary nozzle group 2 for the purpose of description of FIG. 2, the adjustable throttle valve 42 in the first bypass line 47 has less restriction of air flow than the fixed throttle valve 21 in the main line 16, or the former throttle valve 42 has very little restriction. On the other hand, the adjustable throttle valve 57 in the second bypass line 62 is more restricted than the throttle 21. Therefore, air flow through

the first bypass line 47 is greater than through the main line 16, so that air injection pressure of the auxiliary nozzles 2a-2e when supplied with air through the first bypass line 47 is higher than when supplied through the main line 16. Air flow through the second bypass line 62 is less than through the main line 16, so that air injection pressure of the auxiliary nozzles when supplied with air through the second bypass line is lower than when supplied through the main line. As an alternative means for producing an air jet of a higher pressure by the auxiliary nozzles 2a-2e, air flow through the main line 16 and that through the second bypass line 62 may be combined at the distributor 8, With the first bypass line 47 dispensed with. The above arrangement is true of the other groups of auxiliary nozzles 3, 4, 5, 6.

Supposing that the weft detector 34 is actuated to detect the leading end of an inserted weft Y at a time which is later than required by the predetermined range of permissible arrival time, the controller 26 responds to a signal then generated by that weft detector and commands the solenoids for the valves 37, 38, 39, 40 to be energized so that the valves in the first bypass lines 47, 48, 49, 50 for the group of auxiliary nozzles 2, 3, 4, 5 are opened.

Because the weft Y is then subjected to air jets of high pressure issued from the auxiliary nozzles 2a-2e, 3a-3e, 4a-4e, 5a-5e on both upstream and downstream sides of the weft detector 34, the weft can be accelerated so as to recover the delay without being tensioned excessively. Thus, application of excessive tension to the flying weft and failure in weft insertion due to a weft break caused by such excessive tension can be prevented and, therefore, the hand of the resulting fabric will not be affected.

If it is found by the next weft detector 35 that the delay is remedied successfully, assistance by the auxiliary nozzles in flying the weft through the shed is done by air jets under normal pressure and at normal sequential injection times. Should the delay still fail to fall within the permissible range of arrival time at the weft detector 35, however, the controller 26 commands the solenoid valves 37, 38, 39, 40, 41 in the first bypass lines 47, 48, 49, 50, 51 to be opened, thereby activating the auxiliary nozzles 2a-2e, 3a-3e, 4a-4e, 5a-5e, 6a-6e so as to provide air jets of high pressure therefrom, as indicated by the diagram in FIG. 3, in which the shaded areas represent incremental pressure with respect to the normal pressure obtained when air is allowed only through the main line 16-20. If the weft arrival time at the next weft detector 36 again fails to fall within the permissible range, the controller 26 responding to a signal therefrom causes the solenoid valves 38, 39, 40, 41 to be opened, thereby allowing the auxiliary nozzles 3a-3e, 4a-4e, 5a-5e, 6a-6e to issue air jets of high pressure. Thus, the weft Y again receives accelerating action by air jets of high pressure from the auxiliary nozzles located on both upstream and downstream sides of the weft detector at which the delay is detected, with the result that the delay can be recovered without causing harmful tension to the weft and, therefore, failure in weft insertion due to the harmful tension applied to the weft during acceleration can be prevented successfully.

On the other hand, should the weft detector 34 is actuated to detect the leading end of an inserted weft Y at a time which is earlier than required by the range of permissible arrival time, the controller 26 responds to a signal from that weft detector 34 and commands the solenoids for the valves 52, 53, 54, 55 to be energized so that the valves in the second bypass lines 62, 63, 64, 65 for the group of auxiliary nozzles 2, 3, 4, 5 are opened, with the solenoid valves 30, 31 in the main line 19, 20 kept closed, so that air jets under low pressure are injected from the activated auxiliary nozzles. As a result, the weft Y arriving at the weft detector 34 too early is decelerated. If the next weft detector 35 still finds that the leading end of the weft Y arrives thereat too early, the deceleration is continued by injection of low pressure air from the auxiliary nozzle groups 2, 3, 4, 5, 6, as indicated by the diagram shown in FIG. 4 in which the shaded areas represent reduction in pressure with respect to the normal pressure produced when air is allowed only through the main lines 16-20.

Because the weft Y is decelerated under the influence of air jets of low pressure from the auxiliary nozzles located not only on the downstream side of the weft detector then responding to too early arrival of the weft, but also on the upstream side thereof, the weft can be decelerated without being flexed or loosened and it can arrive timely at the weft feeler 7.

As an alternative method of deceleration, it may be so controlled that air jets of low pressure are provided by those auxiliary nozzle groups which are located downstream with respect to the weft detector then responding to too early arrival and also the auxiliary nozzle group corresponding to that weft detector, or that low pressure air jets are issued from the above nozzles in a sequential manner with a shorter period of injection time. In this embodiment of controlling method, the weft can be decelerated to a greater extent than in the embodiment described with reference to FIG. 4.

As understood readily by those skilled in the art, the flow restriction of the throttle valves 42-46 and 57-61 in the first and second bypass lines 47-51 and 62-66, respectively, can be adjusted as required when handling different kinds of weft. it is also noted that the first bypass lines 47-51 may dispense with the throttle valves 42-46.

The intended effect of the invention may be achieved by connecting the first and second bypass lines with separate high-pressure and low-pressure air reservoirs, respectively, with their throttle valves removed.

FIG. 5 shows still another embodiment of the weft insertion controlling method according to the present invention. In this embodiment, if a delay in weft arrival time is detected, e.g., by the weft detector 34, the auxiliary nozzles in the group 4 continue to inject air under normal pressure for a longer period of time than normal and the auxiliary nozzles in the group 5 provide air under high pressure so that it acts on the leading end portion of the weft. Since air jet is most influential on weft flying when it acts on the leading end portion of a weft, this embodiment can exhibit the same effect even if the pressure of air jet applied to the upstream portion of the weft is lower. This embodiment is advantageous in that air consumption can be reduced. It is to be noted that this embodiment should be performed desirably when the delay in weft arrival time is relatively little, whereas, when the delay is large, the controlling should be performed according to the embodiment as described with reference to FIG. 3. Thus, an appropriate embodiment of the weft insertion controlling method should be chosen with the weft flying condition taken into careful consideration.

The method provides controlling weft insertion in a jet loom which can ensure safe and complete weft insertion through a shed even under the influence of a change in weft flying speed, acceleration or deceleration, due to a change in air injection from the auxiliary nozzles and provide uniform hand in the resulting fabric.

The method of controlling weft insertion is adapted for use in a jet loom having at least one weft detector for detecting the leading end of an inserted weft for each weft insertion at a position defined by said weft detector on the way of weft flying along a weft insertion passage of the loom to determine a time at which said leading end arrives at said position and a plurality of auxiliary nozzles whose operation may be controlled according to a signal from said weft detector. The method is characterized in that said time at which the leading end of said inserted weft has actually arrived at said position is compared with a reference weft arrival time, and fluid injection from any auxiliary nozzles located upstream and downstream of said position of the weft detector are compensated for as required according to information from the comparison.

EFFECT OF THE INVENTION

As it is apparent from the foregoing description, the weft insertion controlling method of the invention, according to which the weft is subjected to air jets of high or low pressure from the auxiliary nozzles located not only on the downstream side of the weft detector then responding to too late or too early arrival time of the weft, but also on the upstream side thereof, the acceleration can be accomplished without causing harmful tension to the weft and the deceleration without loosening the same, with the result that failure in weft insertion can be prevented and weaving of fabric with uniform hand is made possible.

DESIGNATION OF REFERENCE NUMERALS

1 .... Main nozzle,
2, 3, 4, 5, 6 .... Auxiliary nozzle groups,
7 .... weft feeler,
8, 9, 10, 11, 12 .... Air distributors,
13 .... Air supply reservoir,
14 .... Air regulator,
15 .... Air source,
16, 17, 18, 19, 20 .... Main lines,
21, 22, 23, 24, 25 .... Throttle valves,
26 .... Controller,
27, 28, 29, 30, 31 .... Solenoid-operated valves,
32, 33, 34, 35, 36 .... Weft detectors,
37, 38, 39, 40, 41, 52, 53, 54, 55, 56.... Solenoid-operated valves,
42, 43, 44, 45, 46, 57, 58, 59, 60, 61.... Adjustable throttle valves,
47, 48, 49, 50, 51 .... First bypass lines,
62, 63, 64, 65, 66 .... Second bypass line,
49 .... Solenoid-operated valve,
Y .... Weft

Claims

1. A method of controlling weft insertion in a jet loom having at least one weft detector for detecting the leading end of an inserted weft for each weft insertion at a position defined by said weft detector on the way

of weft flying along a weft insertion passage of the loom to determine a time at which said leading end arrives at said position and a plurality of auxiliary nozzles whose operation may be controlled according to a signal from said weft detector, said method being characterized in that a time at which the leading end of said inserted weft has actually arrived at said position is compared with a predetermined reference weft arrival time, and fluid injection from any auxiliary nozzles located upstream and downstream of said position of the weft detector are compensated for as required according to information from the comparison.

2. A method of controlling weft insertion in a jet loom as claimed in claim 1, wherein the valve of one or a plurality of bypasses for the jet fluid supplied to one or more of the auxiliary nozzles are actuated in a way that depending on the information from the comparison, the fluid injection pressure of the auxiliary nozzles is increased or decreased, compared to the jet fluid pressure supplied by the main lines.

3. A method of controlling weft insertion in a jet loom as claimed in claim 2, wherein the jet fluid pressure of auxiliary nozzles is increased by connecting a bypass supplying jet fluid of higher pressure to the auxiliary nozzles, compared to the jet fluid pressure supplied by the main conduit line.

4. A method of controlling weft insertion in a jet loom as claimed in claim 2, wherein the jet fluid pressure of auxiliary nozzles is decreased by connecting a bypass supplying jet fluid of lower pressure to the auxiliary nozzles, compared to the jet fluid pressure supplied by the main conduit line.

5. A method of controlling weft insertion in a jet loom as claimed in claim 4, wherein the jet fluid supply by the main conduit line to the auxiliary nozzles is decreased or stopped.

6. A method of controlling weft insertion in a jet loom as claimed in any of claims 1 to 5 wherein the bypasses are bypassing the main fluid supply conduit line.

7. Jet loom operated according to a method as claimed in any of claims 1 to 6.

8. Air jet loom operated according to a method as claimed in any of claims 1 to 6.

Fig. 1

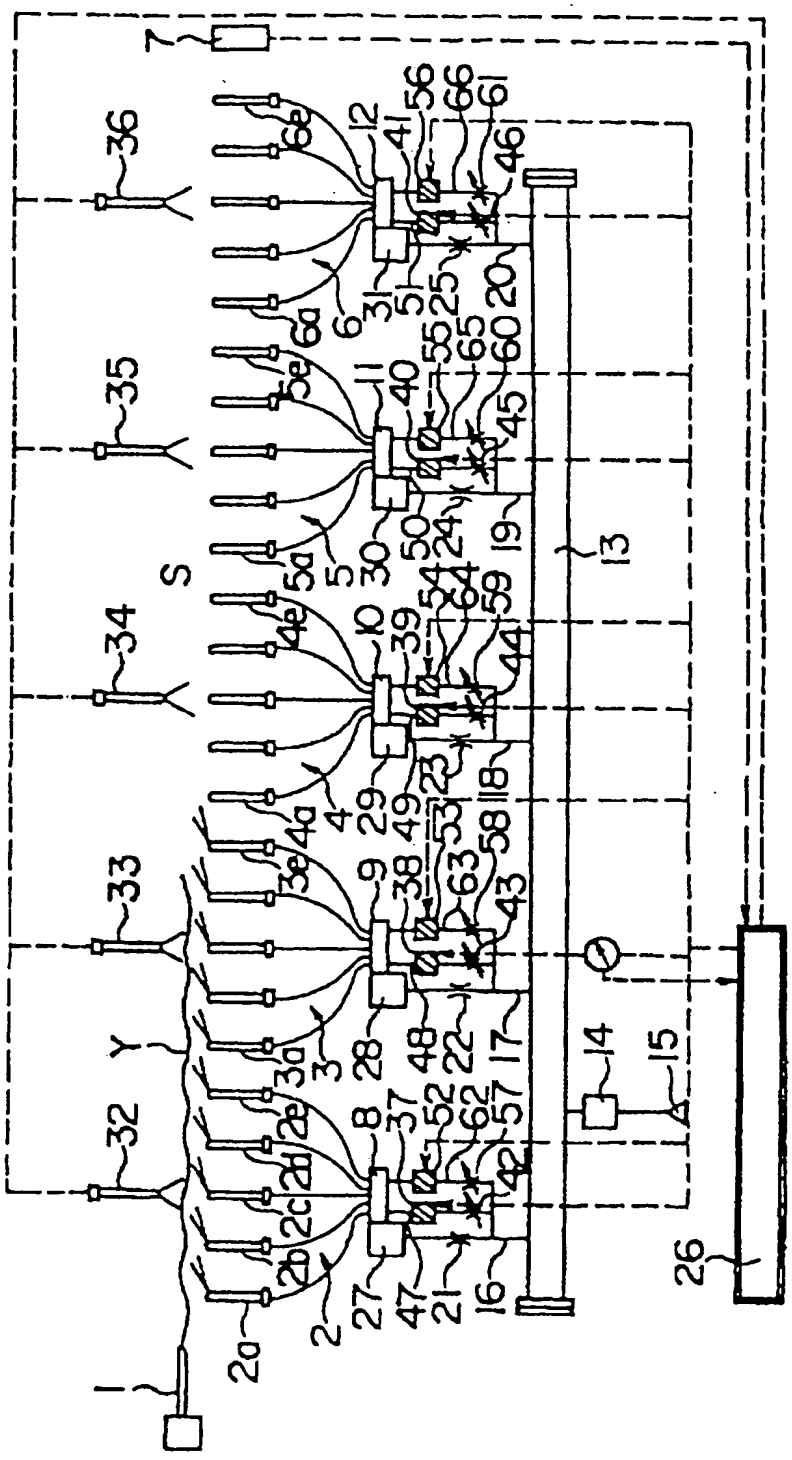
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Fig. 2

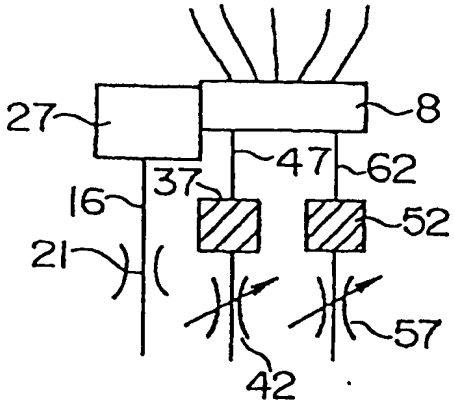
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Fig. 3

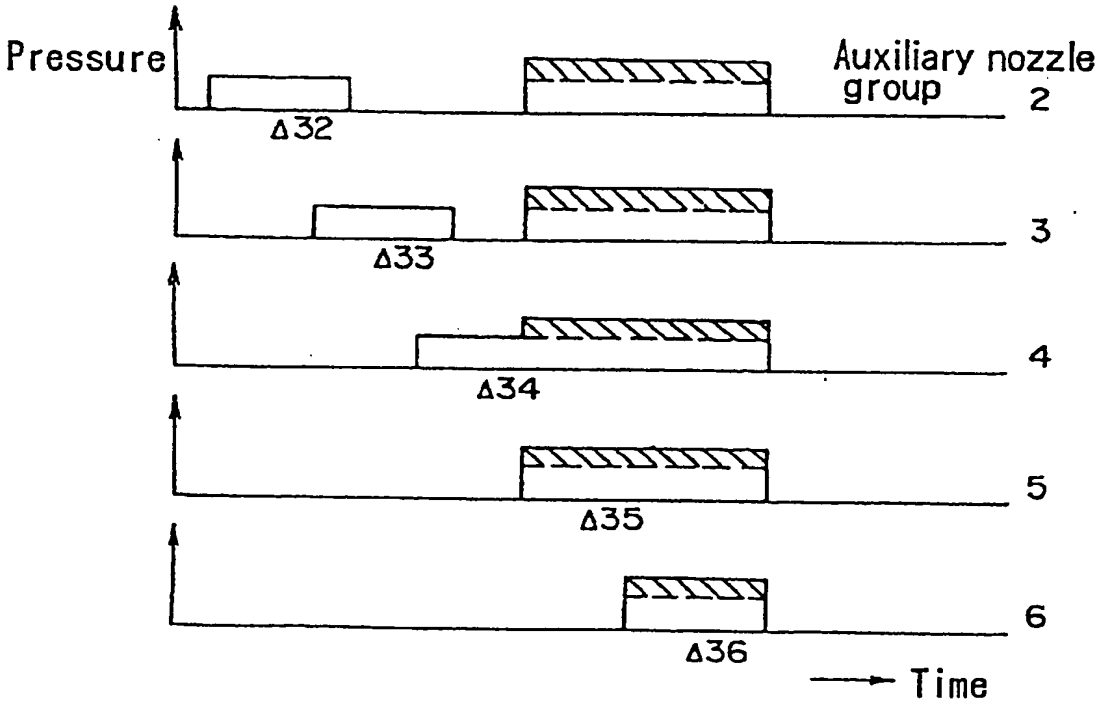

Pressure
Auxiliary nozzle group
2
Δ32
3
Δ33
4
Δ34
5
Δ35
6
Δ36
Time

Fig. 4

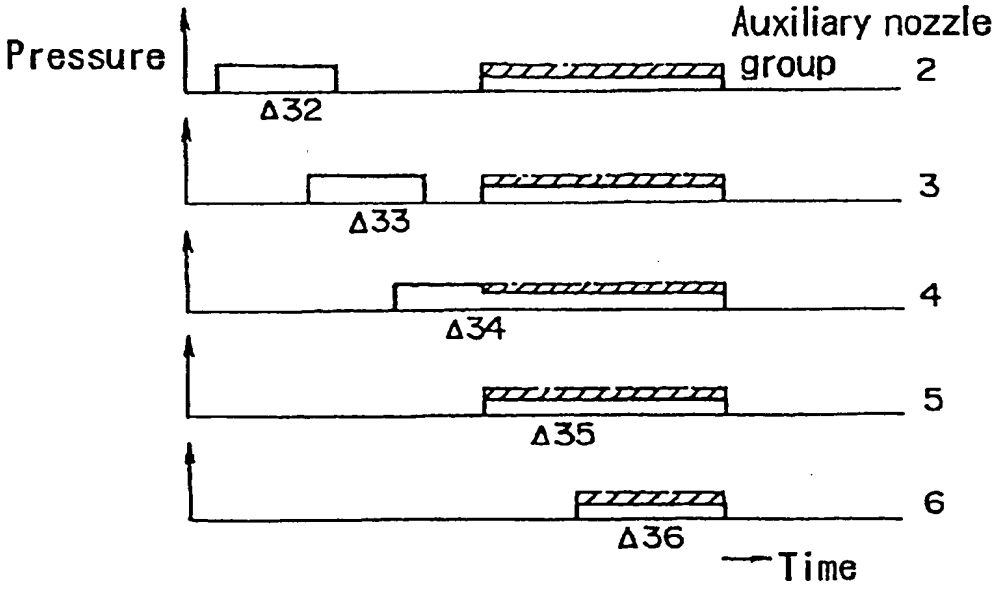
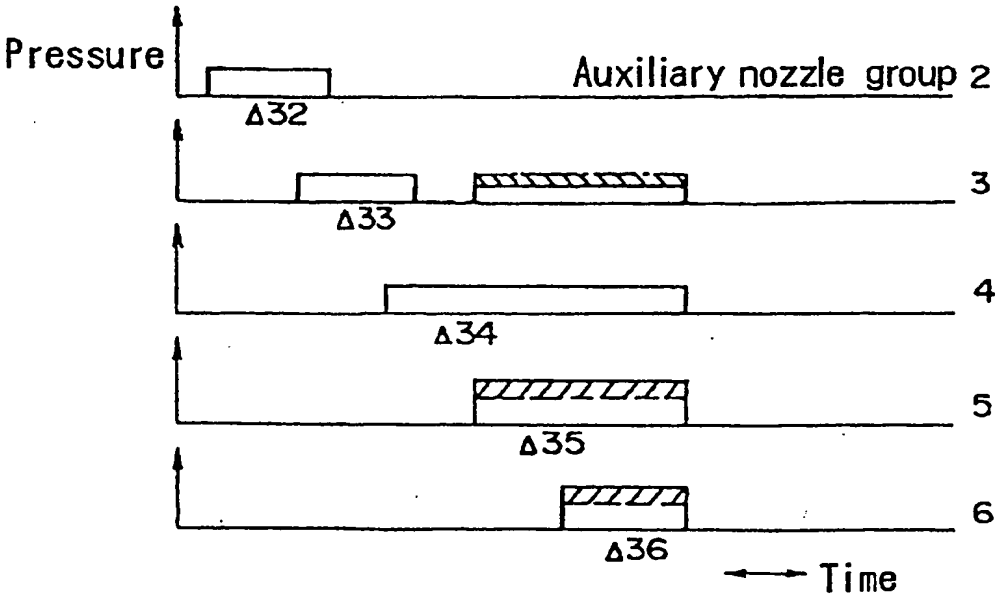

Pressure
Auxiliary nozzle group
2
3
4
5
6
Δ32
Δ33
Δ34
Δ35
Δ36
Time

Fig. 5


Pressure
Auxiliary nozzle group
2
3
4
5
6
Δ32
Δ33
Δ34
Δ35
Δ36
Time

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 81 0048

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 238 128 (PICANOL) * page 4, line 17 - page 6, line 30; figures 1-3,12 * * page 8, line 27 - page 9, line 12 *	1,7,8	D03D47/30
A,P	EP-A-0 494 050 (K.K. TOYODA)		
A	US-A-4 895 188 (LONG)		
A	EP-A-0 465 928 (VAMATEX)		
A,D	JP-A-62 257 441 (TOYODA)		
A,D	JP-A-58 036 242 (...)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 APRIL 1993	BOUTELEGIER C.H.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

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